

BACKPACK SUSPENSION SYSTEM

Cross-Reference to Related Applications

The benefit of Provisional Application No. 60/454,356 filed March 14, 2003 is claimed under 35 U.S.C. §119(e), and the entire content thereof is expressly incorporated
5 herein by reference thereto.

Technical Field of the Invention

The present invention relates generally to backpacks and other load carrying systems. More specifically, the present invention relates to backpacks and load carrying
10 systems that dynamically distribute the load to a wearer's body.

Background of the Invention

Backpacks are commonly used in recreational activities, such as hiking, climbing and skiing, to carry clothing, food, water, shelter, equipment and various other
15 items. Backpacks are also used in everyday activities to carry items such as books, files and computers. Conventional backpacks typically employ a shoulder harness that extends over one or both of the wearer's shoulders in conjunction with a waist belt that wraps around the wearer's waist. The shoulder harness and waist belt allow the load of the backpack (and its contents) to be distributed over both the wearer's shoulders and waist.

20 Various movements of the backpack wearer may cause the load of the backpack to undesirably shift to one side of the body or the other. For example, rocking of the wearer's hips during walking or hiking (as a result of the wearer's natural gait) may cause the backpack and/or the load to shift with respect to the wearer's body, undesirably emphasizing the load on one of the hips, and/or on one or both of the shoulders. This
25 shifting is often emphasized in situations where the wearer is traveling uphill, downhill, or across off-camber, rough and/or uneven terrain.

Numerous backpack suspension systems have been developed to reduce the shifting of the load on the wearer's body. For example, backpacks have been developed with semi-rigid frames that flex along with the wearer's body to reduce the shifting of the
30 load. In addition, backpacks have been developed with pivoting hip belts that pivot to compensate for movement of the wearer's hips relative to the rest of their body. These packs, however, fail to adequately compensate for the shifting of the load. Therefore, there remains a need in the art for a backpack suspension system that evenly distributes the backpack's load over the wearer's body throughout various movements and shifting of the
35 body.

Summary of the Invention

The present invention is directed to a suspension system for a backpack, including a rocker arm pivotally connected to the backpack, a first hip stay having a first end connected to a first end of the rocker arm and a second end opposite the first end, and a second hip stay having a first end connected to a second end of the rocker arm and a second end opposite the first end. The first end of the first hip stay may be flexibly or substantially rigidly connected to the first end of the rocker arm, and the first end of the second hip stay may be similarly connected to the second end of the rocker arm. A waist belt is attached to the second ends of the first and second hip stays. The load of the backpack and its contents may be dynamically transferred from the backpack to the waist belt through the first and second hip stays. The first end of the first hip stay may be flexibly connected to the first end of the rocker arm by a first resilient member, and the first end of the second hip stay may be flexibly connected to the second end of the rocker arm by a second resilient member. The second ends of the hip stays may attach to the waist belt at points that are substantially adjacent opposite sides of a wearer's hips. As a result, the backpack may present a downward force on the wearer that is concentrated within a central region of the wearer's skeletal frame.

The suspension system may further comprise a mounting plate to which the rocker arm is pivotally connected. A tail stay may extend from the mounting plate to the waist belt intermediate the first hip stay and the second hip stay, and serve to stabilize movement between the backpack and the waist belt.

The backpack may include a shoulder harness that is spaced a vertical distance from the waist belt, wherein the first and second hip stays allow the vertical distance between the shoulder harness and the waist belt to increase or decrease to compensate for changes in length of the wearer's spine during bending movements.

The present invention is also directed to a backpack incorporating the suspension system.

Brief Description of the Drawings

The detailed description will be better understood in conjunction with the accompanying drawings, wherein like reference characters represent like elements, as follows:

FIG. 1 is a perspective view of one illustrative embodiment of a backpack incorporating a suspension system according to the present invention;

FIG. 2 is an elevational view of the back portion of the backpack of FIG. 1, with portions of the suspension system shown in hidden lines;

FIG. 3 is an elevational view of the suspension system of FIG. 2, shown removed from the backpack;

5 FIG. 4 is an enlarged, partial view of the suspension system of FIG. 3;

FIG. 5 is a side view of a portion of the backpack of FIG. 1; and

FIG. 6 is a perspective view of the suspension system of the present invention shown being worn by a mannequin.

10 Detailed Description of the Preferred Embodiments

Referring to FIG. 1, an illustrative embodiment of a backpack incorporating a suspension system according to the present invention is shown. Backpack 10 generally includes a pack bag 12 for storing items to be carried, and a lid 14 removably attached to the pack bag 12 to provide access to the interior of the pack bag 12. Backpack 10 may also
15 include various other straps and accessories, such as compression straps 16 and/or a bungee cord 18. It should be noted, however, that the principles of the present invention are not limited to any specific type of backpack construction, and that the suspension system of the present invention may be used with backpacks or other load carrying devices having any shape, size or configuration known to one of ordinary skill in the art. For example,
20 backpack 10 may have a zippered opening instead of the removable lid 14 shown in FIG. 1.

As shown in FIG. 2, the suspension system 20 is associated with the rear wall 22 of backpack 10, and connects a waist belt 24 to the pack bag 12. The waist belt 24 is shaped and configured to be worn around a wearer's waist, and supports all or a portion of the load of the backpack 10 (and its contents) on the wearer's body. Waist belts of many
25 different shapes, materials and constructions are known in the art, and the suspension system of the present invention is not limited to use with any specific type of waist belt.

As also shown in FIG. 2, backpack 10 may include one or more adjustable shoulder straps 26 (or a harness system) that, if provided, work in conjunction with the waist belt 24 to support the load of the back pack 10 (and its contents) on the wearer's body.
30 The shoulder strap(s) 26 may extend from an upper region of the backpack 10 and loop over a wearer's shoulders and connect with a lower region of the backpack 10. For example, shoulder strap(s) 26 may connect to the upper region of backpack 10 via an adjustable frame sheet 67 (shown in FIG. 6) that is associated with the rear wall 22 of the backpack 10, and connect to the lower region of the backpack 10 via the rear wall 22. Alternatively, the
35 shoulder strap(s) 26 may connect to the upper region of backpack 10 directly via the rear

5 wall 22. One of ordinary skill in the art, however, will know and appreciate that the present invention is not limited to any specific connection between the shoulder strap(s) 26 and the backpack 10. Moreover, many different types of shoulder straps and harness systems are known in the art, and the suspension system of the present invention is not limited to use with any specific type of shoulder strap(s) or harness systems, nor is it limited to use with shoulder strap(s) or a harness system at all.

Referring to FIGS. 3 and 4, the suspension system 20 includes a mounting plate 28 that is attached to the rear wall 22 of the pack bag 12. Mounting plate 28 may be formed of a rigid or semi-rigid material, such as ABS plastic, polyethylene, nylon, delrin, reinforced thermosets (such as epoxy and fiberglass), aluminum or titanium, however any other suitable material known to one of ordinary skill in the art may be used as well. The mounting plate 28 may be attached to the rear wall 22 of the pack bag 12 by strips of fabric 30 (shown in FIG. 2) which are sewn to the rear wall 22 and extend across tabs 32 formed on mounting plate 28, as well as by a snap connector 34 that attaches to the rear wall 22. Additionally or alternatively, the mounting plate 28 may be attached to the rear wall 22 by riveting, stitching, bonding, stapling, sewing, or any other technique known to one of ordinary skill in the art.

Suspension system 20 also includes a rocker arm 36 that is pivotally connected to the mounting plate 28 and pivots about pivot axis P. A bolt 38 extends through aligned bores in mounting plate 28 and rocker arm 36, along pivot axis P, and results in the pivoting connection between these two parts. Suitable materials for the rocker arm 36 include, for example, nylon, reinforced nylon, polyacetal, sheet molding compounds, bulk molding compounds, composites, and metals.

To smoothen the pivoting action between mounting plate 28 and rocker arm 36, the rocker arm 36 may have a bearing 40 (such as a cartridge-type ball bearing) surrounding the bolt 38, as shown in FIG. 4. Alternatively, a bushing or other member may surround the bolt 38, to provide some resistance to pivoting of rocker arm 36 with respect to mounting plate 28, and to provide a degree of damping to the suspension system 20. Mounting plate 28 may include raised regions, such as raised regions 28a and 28b, which may engage rocker arm 36 to prevent over-rotation of rocker arm 36.

Still referring to FIGS. 3 and 4, suspension system 20 also includes first and second hip stays 50, 52, each of which have first ends 50a, 52a, respectively, that are connected to opposite first and second ends 36a, 36b of rocker arm 36. As shown in FIG. 4, the first end 50a of first hip stay 50 may be flexibly connected to the first end 36a of rocker arm 36 by a resilient member 54. Similarly, the first end 52a of second hip stay 52 may be

flexibly connected to the second end 36b of rocker arm 36 by a resilient member 56. Suitable materials for resilient members 54, 56 may include, for example, polyurethane or nitrile rubber, or any other resilient materials known to one of ordinary skill in the art. Still referring to FIG. 4, end portion 54a of resilient member 54 may be received in a bore 58 located in the first end 36a of rocker arm 36, and the other end portion 54b may be located in a bore 60 in the first end 50a of first hip stay 50, with a central portion 54c of resilient member 54 exposed to provide the flexible connection. Resilient member 56 may be attached to the second end 36b of rocker arm 36 and the first end 52a of second hip stay 52 in the same manner. Co-molding, bonding, press-fitting, pinning, screwing, or other techniques known to one of ordinary skill in the art may be used to secure the resilient members 54, 56 in the respective bores. The flexible connection between the first and second ends 36a, 36b of rocker arm 36 and the first and second hip stays 50, 52 may alternatively be provided by a ball-and socket joint or a pivoting connection (such as described above with respect to rocker arm 36), however it is preferable that there be some amount of resistance to movement between the hip stays 50, 52 and the ends 36a, 36b of the rocker arm 36, to prevent the suspension system 20 from being over flexible or collapsing under heavy loads. According to another alternative embodiment, the rocker arm 36 and the first and second hip stays 50, 52 may be formed integrally, with the flexible connections provided by a thinned region in the members, such as is commonly referred to as a "living hinge." According to yet another alternative embodiment, the first ends 50a, 52a of the first and second hip stays 50, 52 may be substantially rigidly attached to the first and second ends 36a, 36b, respectively, of the rocker arm 36. This may be achieved, for example, by forming the rocker arm 36 and the first and second hip stays 50, 52 as a monolithic structure, or alternatively, by any method of rigid attachment known to one of ordinary skill in the art.

First and second back stays 64, 66 may be connected to the mounting plate 28, as shown in FIG. 3, and extend upwards along the path of the wearer's back. The first and second back stays 64, 66 act to reinforce and/or stiffen the rear wall 22 of the pack bag 12. A frame sheet 67 of rigid or semi-rigid material (shown in FIG. 6) may be placed over the back stays 64, 66 to further reinforce and/or stiffen the rear wall 22, and/or to prevent objects stored in the pack bag 12 from poking the wearer's back. The frame sheet 67, if provided, may also serve as an anchor point for the optional shoulder straps 26, as shown in FIG. 6. A tail stay 68 may extend downward from the mounting plate 28, as will be discussed in more detail below. The back stays 64, 66 and the tail stay 68 may be connected to the mounting plate 28 by riveting, screwing, stapling, stitching, bonding or

other techniques known to one of ordinary skill in the art; alternatively, the back stays 64, 66 and the tail stay 68 may be formed integrally with the mounting plate 28.

Suitable materials for the first and second hip stays 50, 52, back stays 64, 66 and tail stay 68 may include, for example, composites such as fiberglass, carbon fiber or other reinforcing fibers along with epoxies, acrylics and nylons, as well as metals such as aluminum and titanium, although other materials may be used instead.

Referring back to FIG. 2, the second ends 50b, 52b of the first and second hip stays 50, 52, respectively, are connected to the waist belt 24 at first and second attachment points 70, 72. Attachment points 70, 72 are preferably located substantially adjacent the opposite right and left sides of a wearer's hips when wearing the waist belt 24, thus transferring the load of the backpack (and its contents) to the sides of the wearer's hips, and disbursing it evenly from there. The rocker arm 36 in conjunction with the first and second hip stays 50, 52 provides a suspension between the pack bag 12 and the waist belt 24 through which the load of the pack bag 12 is dynamically transferred to the waist belt 24. This system equally transfers the load to both sides of the body (*e.g.*, to the right and left hips) throughout various movements and shifting of the wearer's body, and prevents the load from being pushed into a position of instability. As a result, the backpack's movements match the wearer's, substantially preventing an undesirable shift of weight from the waist belt 24 to one or more of the shoulder straps 26, and maintains the load on both sides of the wearer's hips regardless of movement. The backpack 10 may also include an optional back pad 73 (shaded gray in FIG. 2) that extends over the mounting plate 28, rocker arm 36 and at least a portion of the first and second hip stays 50, 52 to provide a layer of padding between the wearer's back and the suspension system 20. As shown in FIG. 2, this back pad 73 may be formed integrally with the shoulder straps 26, to form an integral back pad/shoulder harness assembly. If the back pad/shoulder harness assembly is provided, its vertical position on the rear wall 22 of the pack bag 12 may be adjustable, via a buckle 74, to adjust the vertical distance between the shoulder straps 26 and the waist belt 24 to accommodate wearer's having different length torsos.

Still referring to FIG. 2, the end of tail stay 68 is attached to waist belt 24 at a third attachment point 76, which is located intermediate the first and second attachment points 70, 72. The tail stay 68 acts to stabilize movement between the pack bag 12 and the waist belt 24 (*e.g.*, to control or dampen swaying of the pack bag 12 with respect to the waist belt 24 during times of rapid or extreme movements). The tail stay 68 may be a zero force member, meaning that little or none of the load of the backpack (and its contents) is directed from the pack bag 12 to the waist belt 24 through the tail stay 68. This may be

accomplished as a result of a slidable connection between the tail stay 68 and the waist belt 24, which will be described in more detail below.

Referring to FIGS. 2, 5 and 6, the interface between the first and second hip stays 50, 52 and the waist belt 24 is shown. The second ends 50b, 52b of the first and second hip stays 50, 52 may be slidably connected to the waist belt 24 at the first and second attachment points 70, 72 respectively, to allow for generally vertical motion between the waist belt 24 and the first and second hip stays 50, 52. For example, as shown in FIGS. 2, 5 and 6, first and second pockets 80, 82 may be formed on the waist belt 24 at the first and second attachment points 70, 72, for slidably receiving the second ends 50b, 52b of the first and second hip stays 50, 52, respectively. Pockets 80, 82 may be formed by sewing segments of nylon webbing onto the waist belt 24 at the first and second attachment points 70, 72, although the present invention is not limited to any specific construction of pockets 80, 82. First and second pockets 80, 82 may have ends 80a, 82a closed (*e.g.*, by stitches) to prevent the second ends 50b, 52b of the first and second hip stays 50, 52 from sliding therethrough, or alternatively, ends 80a, 82a may be open to allow the second ends 50b, 52b of the first and second hip stays 50, 52 to slide therethrough. As shown in FIGS. 2 and 6, tail stay 68 may be similarly attached to the waist belt 24 at third attachment point 76 by a third pocket 86 (constructed in the same or a similar manner as the first and second pockets 80, 82, described above). It is preferable that the end 86a of third pocket 86 is open sufficiently to allow the tail stay 68 to freely slide therethrough, so that little or none of the load of the backpack is directed from the pack bag 12 to the waist belt 24 through the tail stay 68.

The slidable connection of the first and second hip stays 50, 52 and the tail stay 68 with the waist belt 24 allows the backpack to increase or decrease in length to accommodate the effective lengthening of the spine (and torso) that occurs during bending movements (*e.g.*, the effective length of the wearer's spine increases as the wearer bends over forward). That is, the first and second hip stays 50, 52 and the tail stay 68 can slide with respect to the pockets 80, 82, 86 to allow the vertical distance Y (represented in FIG. 2) from a predetermined point on the shoulder straps 26 to a predetermined point on the waist belt 24 to vary to accommodate changes in the effective length of the wearer's spine. This helps to eliminate riding up of the waist belt 24 on the wearer's hips during bending movements, as is common with conventional backpack designs.

Referring to FIGS. 5 and 6, the hip stays 50, 52 may curve forward towards the front of the wearer such that the first and second attachment points 70, 72 (where the hip stays 50, 52 attach to the waist belt 24) are substantially adjacent the sides of the wearer's

hips. This causes the downward force or load of the backpack 10 to be applied to the wearer at the sides of his or her hips, resulting in the downward force or load being concentrated on the central region of the wearer's skeletal frame (*e.g.*, toward the center of a circle defining the wearer's waist) as opposed to being concentrated at a point offset to the back of the wearer's torso, which would result in a moment that is off-center to the skeleton.

While the foregoing description and drawings represent the preferred embodiments of the present invention, it will be understood that various additions, modifications and substitutions may be made without departing from the spirit and scope of the present invention as defined in the accompanying claims. The presently disclosed embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims, and not limited to the foregoing description.